

—not at all like the common foothill fern in aspect—which comes close to the outlying forms of *compacta* as that species reaches its lower limits. *Fosberg* 8497, San Antonio Canyon, 4500 feet, represents this phase.

On the other hand when *Pellaea compacta* grows in partial shade under pines it may assume the habit of *P. mucronata* in bearing the pinnae divaricately, in the manner of the Arizonan *Pellaea Wrightiana*. This condition is illustrated by *Johnston* 1593, San Antonio Canyon, San Gabriel Mountains, at 5750 feet—about the lower altitudinal limit for *compacta*!—and a likely zone of flux. Here the aspect of *compacta* is quite unlike plants at higher altitudes in the same range. Furthermore, when this species grows in deep north-facing crevices of boulders the pinnae may assume more widely atypical asplenoid forms (*fig. 1, b*) with a few plane rounded pinnules. Growing at the same station, however, at Big Cienaga above Crystal Lake, San Gabriel Mountains (at 6500 feet—here the zone of flux because of the ascent of the Sonoran elements immediately below to raise the whole zonation), are plants of *compacta* (*Ewan* 2703) with divaricate pinnae and of open habit, nearly plane, and only slightly glaucous, whereas typical *compacta* is often distinctly glaucous. Still other plants from this station (*Ewan* 2702), growing in the full sun, match the Lemmon collection above cited from the San Bernardino Mountains in all characters. It is such a typical collection (*Fosberg & Ewan* 4891—though not the Big Cienaga collection referred to above) that is illustrated by *fig. 1, a*. Careful search will then disclose what might be taken as negative evidence for concluding that *Pellaea compacta* is a valid species, but there appears to me to be yet another justified conclusion and disposition.

The systematic relationship in these ferns introduces a principle in the treatment of “unstable species” that, as a working idea, merits consideration. Both *Pellaea mucronata*, conceivably the parent species, and *Pellaea compacta*, the derived species resulting from isolation, in part, and its multiplex resulting factors, are very susceptible to an abnormal environment, with consequent morphological changes away from those characters exhibited by plants of typical habitats. Especially does this reaction occur when the two species approach their altitudinal limits. Irrespective of such uncertain forms as may be found, not at once referable to either species but always peripheral in distribution and numerically few among the species as a whole, a sound working basis is to maintain the limits, when well-defined, as distinct species. Perhaps a parent species and such a limital one may represent a confluent unit, were all the intercalary states known. Nevertheless the recognition of such limital species awaits the day, perhaps decades distant, when a comprehensive knowledge from several correlated fields of study will relate the data presented by new collections in the then better understood mosaic of life forms among plants. The chief disadvantage with the practice of relating minor or questionable limital forms to another long-known species on present incomplete evidence is the fact that such a practice

hides away these plants from the critical observation which might easily be given them were they maintained by botanists on "trial grounds." A recommended practice for the consideration of such uncertain (published) forms in manuals and floras is that in favor among many botanists in giving a characterization (preferably quite full, if not verbatim, from the original description) of such forms, without keying them, as a subhead near the most closely related keyed species.

Therefore, when a plant exhibits a clear set of morphological characters under optimum growing conditions for that species and these characters recur among plants found in similar floristic areas, I favor the recognition of such plants (the "extremes" of some botanists) as species. Many such species may be found commonly to terminate a phylogenetic line, recently budding from the parent species, and therefore will be areally limited. The dubious forms that occur between such species would be then considered taxonomically as individuals, at the same time pointing out their avowed differences and affinities and relating them when practicable to the species which they most nearly approach in the sum total of their characters. This treatment, as species, of what have often been considered as "extremes" necessitates the clear definition of such a plant group, repeating an appreciable number of times the characters present over several floristically related stations.¹⁵ Allowing for local or individual genetic variation the majority of the "intermediates" will be found, I believe, to represent plants in active evolution on the margins of their normal ranges, immigrants into new territory.

O. F. Cook's simile in elucidating the species problem is, among the verbiage extant on that topic, a happy one. "The categories of the biologist are artificial like those of the geographer, but not more so. Geographers do not agree in the grouping of the archipelagoes of the Pacific Ocean, but this is not considered a reason for denying that islands exist or that some islands are close together and others far apart. Species are biological islands, in a sea of non-existence."¹⁶ Awaiting the results of studies by the experimental grower, the geneticist, ecologist, and student of nutrition, the systematic botanist holds a probationary attitude toward the lesser known plant forms in an attempt to differentiate between specific units and those marginal states which approach the better known species in one or several characters, meanwhile being in accord with the view that the ultimate "only way to solve taxonomical difficulties with polymorphic species goes along lines of experimental research."¹⁷

¹⁵ For "narrow endemics" 3 or 4 stations would suffice, if these were of the same floristic subarea populated by identical or closely related species at the separate stations.

¹⁶ COOK, O. F. *Existence of species*. Jour. Hered. 5: 158. 1914.

¹⁷ GODDIJN, W. A. *On the species conception in relation to taxonomy and genetics*. Blumea 1: 81. 1934.

SUMMARY

Pellaea compacta (Davenp.) Maxon is believed to have been first collected on the slopes of Mt. San Bernardino, where it grows in fair abundance, though not definitely so stated in Davenport's original description of the fern.

Pellaea compacta, confined to the higher mountains of southern California, morphologically well-defined in its typical state but undergoing wide variation under abnormal environments, is considered specifically distinct from the geographically widespread *Pellaea mucronata*.

The so-called "intermediates" of the two species are found to occur invariably along the margins of their vertical ranges, being absent from *within* the range of typical plants of either species. These outlying forms are generally atypical in only one or two characters which may be understood from field observation to be of edaphic or climatic origin.

Well-defined limital forms (what have often been tagged "extremes") of generally accepted species, sharing with the plants of several floristically related localities definite morphological characters, are recommended to be treated as species.

Atypical forms may be best considered as "near" or "towards" either species according to the sum total of their characters, with a clear statement of their aberrant morphological nature.

BOTANY.—*New species of Bomarea from the Andes.*¹ E. P. KILLIP,
U. S. National Museum.

Bomarea, a genus of Amaryllidaceae, contains some of the most showy plants of the South American mountains. The brilliant flowers, usually red and yellow, are often massed in clusters of 50 or more, and present a striking appearance against the dark green foliage of the forest. Though most of the species are high-climbing vines, some inhabit the high mountain plateaus, and these generally are low erect plants, with stiff narrow leaves.

As a member of expeditions to Colombia and Peru I have made a special study of *Bomarea*, and am preparing a revision of the genus. Since this can not be published at present, and the names of several new species are used in a forthcoming article in *The National Horticultural Magazine*, I am describing herewith eleven as new, most of these based upon material in the herbaria of the Royal Botanic Gardens, Kew, the Muséum National d'Histoire Naturelle, Paris, and the Botanisches Museum, Berlin. To the directors of these institutions I wish to express my appreciation of their many courtesies. Photo-

¹ Published by permission of the Secretary of the Smithsonian Institution. Received June 4, 1935.

graphs, and in some cases fragments of the types, are deposited in the U. S. National Herbarium.

The most comprehensive monographs of Amaryllidaceae are those of Herbert,² Kunth,³ and Baker.⁴ In treating *Bomarea* Baker recognized as subgenera two small groups of species, which both Herbert and Kunth had placed in separate genera, these subgenera being designated by Baker as *Wichaurea* and *Sphaerine*. In classifying the true *Bomareas* Baker followed his predecessors in recognizing four main groups, as follows:

Umbel rays simple.

Petals and sepals subequal (*Multi-florae*).

Petals much longer than the sepals (*Caldasianae*).

Umbel rays forked.

Petals and sepals subequal (*Edules*).

Petals much longer than the sepals (*Vitellinae*).

I have given names to these groups as above, in order to refer to them more readily. The arrangement is not wholly satisfactory, and perhaps does not express the actual relationships of the species, but until more herbarium material, especially more fruiting material, is available, it will suffice.

***Bomarea (Wichaurea) campanuliflora* Killip, sp. nov.**

Caulis strictus (?), parte suprema recurvata, glaber; folia linearia, revoluta, rigida, subtus rufo-pilosula; radii 4, glabri, 1-2-furcati; ovarium \pm superius, glabrum; sepala late ovata, rubra; petala oblanceolato-unguiculata, quam sepala longiora, rubra, apice viridi.

Stem apparently erect, recurved toward apex, about 3 mm. in diameter, leafy except toward base, glabrous; leaves linear, 3 to 9 cm. long, decreasing toward apex, 3 to 6 mm. wide (the upper the broader), crowded, strongly revolute, rigid, sessile, rufo-pilosulous beneath; bracts similar to the leaves, slightly involute; umbel rays 4, about 4.5 cm. long, glabrous, once or twice forked, bracteolate, the lowest bractlets up to 2.5 cm. long; ovary broadly turbinate-campanulate, glabrous, partly superior; sepals broadly ovate, 2 to 2.5 cm. long, 1 to 1.5 cm. wide, acuminate, glabrous, red; petals oblanceolate-unguiculate, 2.5 to 3 cm. long, the blade longer than the claw, 1 to 1.3 cm. wide, acute, red, green-tipped; stamens subequal to the petals, the anthers oblong, about 3.5 mm. long; styles exerted, the stigma shallowly trifold.

Type in the herbarium of the Botanisches Museum, Berlin, collected at Quebrada de Toipata (?), Department of Puno, Peru, August, 1864, by A. Raimondi (no. 10229).

The general appearance of the inflorescence suggests *B. grandis*, but because of the proportionately broad sepals and the strongly involute leaves it is evidently a distinct species.

² HERBERT, W. Amaryllidaceae. 1837.

³ KUNTH, C. S. Enum. Pl. 5: 467-850. 1847.

⁴ BAKER, J. G. Handbook of the Amaryllideae. 1888.

Bomarea (*Wichaurea*) *zosteraefolia* Killip, sp. nov.

Ubique glaberrima; caulis strictus, rigidus, ad apicem recurvatus, foliosis-simus; folia linearia, subrevoluta, membranacea; radii ca. 6, prope medium furcati; ovarium turbinatum; segmenta perianthii subaequalia, sepalis lineari-oblongis, subacutis, petalis oblongo-spathulatis, flavescensibus (?), purpureo-maculatis.

Plant erect, rigid, 30 or more cm. high, glabrous throughout; stem subterete, 2.5 to 4 mm. in diameter, recurved toward apex, densely leafy, the leaves reduced or probably wanting toward base; leaves linear, 4 to 12 cm. long, 2 to 3 mm. wide (diminishing from middle of stem to apex), acute, sessile, slightly revolute, membranous, green on both surfaces, divaricate; bracts similar to the leaves; umbel rays about 6, 2.5 to 3 cm. long, slender, forked near middle, the bractlets similar to the leaves, 1.5 to 2 cm. long; ovary turbinate, sulcate; sepals linear-oblong, about 2.5 cm. long and 6 mm. wide, subacute, red, green-tipped; petals oblong-spatulate, subequal to the sepals, yellowish(?), green-tinged and purple-maculate at apex; stamens subequal to the perianth, the anthers oblong, about 2.5 mm. long; style slightly exerted, trifold.

Type in the herbarium of the Muséum National d'Histoire Naturelle, Paris, collected in the Department of Ancachs, Peru, by Martinet (no. 742).

The longer spreading leaves, which are of a much thinner texture, scarcely revolute, and glabrous beneath, and the diffuse inflorescence are characters by which this may be distinguished from *B. dulcis*, a related species.

Bomarea uniflora (Mathews) Killip

Astroemeria uniflora Mathews; Herb. Amaryll. 104. 1837, as synonym.

Wichaurea dulcis uniflora M. Roemer, Fam. Nat. Syn. 4: 278. 1847.

Bomarea (*Sphaerine*) *incana* Killip, sp. nov.

Caulis strictus, teres, tener, glaber; folia pauca, ovato-oblonga, membranacea, subtus pilis albidis vel brunnescentibus dense hirsuto-tomentosa; radii 1 vel 2, ad medium furcati vel subfurcati, bracteolis foliis similibus; ovarium auguste obconicum, rufo-tomentellum; segmenta perianthii aequalia, sepalis oblongis, petalis oblanceolato-spathulatis, flavis, apice viridi, purpureo-punctatis.

Stem erect, 50 to 60 cm. high, slender, terete, glabrous, leafless in lower half, few-leaved in upper half; leaves sessile or subsessile, ovate-oblong, 4-6 cm. long, 1.2 to 2.3 cm. wide, acute at apex, rounded at base, membranous, glabrous above, densely hirsute-tomentose beneath with white or light brown hairs, the hairs chiefly borne on the side of the veins, divaricate but closely appressed to the blade; bracts 2, similar and equal to the leaves; umbel 1 or 2-rayed, the rays 5 to 12 cm. long, forked near middle (or one fork scarcely developed), bracteolate at fork, the bractlets similar to the leaves, 1.5 to 3 cm. long; ovary narrowly obconic, densely rufo-tomentellous; perianth segments equal, 2 to 2.3 cm. long; sepals oblong, 6 to 9 mm. wide, red and puberulous without, pale and glabrous within; petals oblanceolate-spatulate, the blade 6 to 7 mm. wide, yellow, green-tinged apically and purple-spotted; stamens subequal to perianth; stigma trifold.

Type in the herbarium of the Jardín Botánico, Madrid, collected at the Alto del Cóndor, between Ibagué and El Nevado del Tolima, Department of Tolima, Colombia, altitude 3,500 meters (Central Cordillera), May 17,

1932, by J. Cuatrecasas (no. 2224). Represented also by *Goudot* 4 and *Dawe* 807, from the same general region.

This is nearest *B. holtonii*, also a Colombian species, which has 7 or 8 primary rays, a quadrangular stem, and sparingly pilosulous leaves.

Bomarea (*Eubomarea* § *Caldasianae*) **vegasana** Killip, sp. nov.

Caulis volubilis, angulatus, rufo-tomentulosus; folia lanceolata, subcoriacea, subtus minute puberula; radii ca. 35, simplices, ebracteolati, cum ovario conico viscoso-tomentosi; sepala lineari-oblonga; petala cuneato-unguiculata, sepalis longiora, lutea.

Herbaceous vine; stem rather stout, 4 to 6 mm. wide, angular, densely rufo-tomentulous; petioles 6 to 8 mm. long, winged; leaves lanceolate, 8 to 12 cm. long, 2 to 2.5 cm. wide, acuminate at apex, abruptly narrowed at base, subcoriaceous, glabrous above, minutely puberulent beneath; bracts of 2 forms, the outer oblong-lanceolate, 3 to 5 cm. long, 8 to 10 mm. wide, reflexed, the inner linear, 1 to 1.5 cm. long, 3 mm. wide, suberect; umbel simple, about 35-rayed, the rays 4 to 5 cm. long, ebracteolate, viscoso-tomentose; sepals linear-oblong, about 3 cm. long, 6 mm. wide, red, puberulent without; petals cuneate-unguiculate, about 4 cm. long, the blade subequal to the claw, yellow, not spotted; stamens 3 to 3.5 cm. long, unequal, the anthers ovate-oblong, 6 to 7 mm. long.

Type in the U. S. National Herbarium, no. 1,351,609, collected in mountains east of Las Vegas, Department of Santander, Colombia, altitude 3,300 to 3,400 meters (Eastern Cordillera), December 21, 1926, by E. P. Killip and A. C. Smith (no. 15784). Represented also by *Killip & Smith* 15587, from the same locality.

This closely resembles *B. andreana*, but the petals are definitely unspotted and the leaves, which are of thicker texture, are minutely puberulent beneath.

Bomarea (*Eubomarea* § *Edules*) **subsessilis** Killip, sp. nov.

Caulis substrictus et subflexuosus, tenerrimus, glaber; folia oblanceolata vel elliptica, ad basin attenuata, subsessilia, subtus breviter crispato-pilosa; bracteae 2; radii 2-4, tenerrimi, glabri, 1-2-furcati, bracteolis parvis; ovarium late turbinatum; segmenta perianthii subaequalia, apice viridi, sepalis oblongo-spathulatis roseis, petalis spathulatis-unguiculatis, flavidulis.

Stem 35 to 50 cm. long, suberect or at least very slightly voluble, subflexuose, angulate, slender, glabrous; leaves oblanceolate or elliptic, 2.5 to 5.5 cm. long, 0.7 to 1.8 cm. wide, acute at apex, tapering to base without a well-defined petiole, resupinate, divaricate or somewhat ascending, membranous, glabrous above, short-crispate-pilose beneath; bracts 2, ovate-oblong, 7 to 13 mm. long, 3 to 5 mm. wide; umbel 2 to 4-rayed, the rays slender, 3.5 to 4.5 cm. long, glabrous, once or twice forked, bearing at the forks an ovate-oblong or linear-oblong, reddish bractlet 7 to 10 mm. long; ovary broadly turbinate, 6 to 8 mm. long, up to 6.5 mm. in diameter at apex, about one-fifth superior, longitudinally sulcate, glabrous, black; sepals oblong-spatulate, 1.2 to 1.6 cm. long, 5 to 7 mm. wide, obtuse, reddish pink, green at apex; petals spatulate-unguiculate, subequal to sepals in length and breadth, pale yellow, green-tinged; stamens shorter than the perianth, unequal, the anthers orbicular-oblong, about 1.5 mm. long; pistil subequal to stamens, the stigma trifid.

Type in the herbarium of the Botanisches Museum, Berlin, collected near Cochabamba, Department of Cochabamba, Bolivia, 3,400 meters altitude, February 27, 1928, by C. Troll (no. 1630). Represented also by *Bang* 2039, from the same locality.

This is one of several species that are clearly distinct in themselves but which, because of our imperfect knowledge of the lines of demarcation of the subgenera, are difficult to assign systematically. The suberect habit of the plant, the absence of a definite petiole, and the partly superior ovary suggest the subgenus *Wichaurea*. In other respects it seems more closely allied with the small-flowered species of *Eubomarea* § *Edules*.

***Bomarea* (*Eubomarea* § *Edules*) *campylophylla* Killip, sp. nov.**

Caulis volubilis, teres, glaber; folia lineari-lanceolata, subfalcata, conspicue nervosa, glabra; bracteae foliis similes, falcatae; radii 5 vel 6, subglabri, supra furcati, biflori, 1-2-bracteolati; ovarium cylindrico-turbinatum; segmenta perianthii subaequalia, sepalis oblongis, petalis spathulatis, quam sepalis angustioribus, luteis, purpureo-maculatis, apice viridi.

Herbaceous vine; stem terete, 2 to 3 mm. in diameter, glabrous; petioles up to 6 mm. long, crispate-margined; leaves linear-lanceolate, 6 to 12 cm. long, 1 to 1.5 cm. wide, subfalcate, acuminate at apex, rounded at base, strongly and closely nerved, glabrous, concolorous; bracts similar to the leaves, 7 to 10 cm. long, 5 to 8 mm. wide, falcate; umbel 5 or 6-rayed, the rays 10 to 15 cm. long, divaricate or arcuate-ascending, rufo-puberulent and viscid at apex, otherwise glabrous, forked near apex, 2-flowered, bracteolate at fork and sometimes just below fork, the lower bractlets similar to the bracts, 4 to 5 cm. long; ovary cylindric-turbinate, densely rufo-tomentose; perianth segments subequal, about 1.5 cm. long, the sepals oblong, 7 to 8 mm. wide, red and rufo-puberulent without, yellow within, green at apex, the petals spatulate, slightly narrower than the sepals, yellow, purple-maculate, green at apex; stamens shorter than the perianth, the anthers ovate-oblong, about 2.5 mm. long; style trifid.

Type in the U. S. National Herbarium, no. 1,192,850, collected at Villcabamba, Department of Huánuco, Peru, altitude about 1,800 meters, July 17 to 26, 1923, by J. F. Macbride (no. 4961). Duplicate at the Field Museum.

This is allied to *B. salsilla*, *B. subsessilis*, and *B. nematocaulon*, species of *Eubomarea* § *Edules* with very small flowers, the perianth being not more than 1.5 cm. long. There are many points of difference between these three species and *B. campylophylla*.

***Bomarea pennellii* Killip**

Bomarea longipes Kränzl. Bot. Jahrb. Engler 40: 234. 1908, not Baker, 1882.

In assigning a specific name to this Colombian plant Kränzlin overlooked the earlier use of *longipes* for a wholly different plant from Ecuador. It is appropriate that the species be named for Dr. F. W. Pennell, whose extensive explorations in Colombia have done much to make known the plant life of that country.

Bomarea (*Eubomarea* § *Edules*) **trichophylla** Killip, sp. nov.

Caulis volubilis, glaber; folia ovato-lanceolata, subtus in nervis dense pilosa; radii 4-7, glabri, supra medium 2-3-furcati, bracteolis oblongo-lanceolatis vel lineari-lanceolatis; ovarium late turbinatum, glabrum; segmenta perianthii aequalia, apice viridi, sepalis obovato-oblongis, extra roseis, intus flavidulis, petalis oblongo-spathulatis, luteis; capsula turbinata, aurantiaca.

Herbaceous vine; stem rather slender, 2 to 3 mm. thick, sulcate, glabrous; petioles 1 to 1.5 cm. long, narrowly winged; leaves ovate-lanceolate, 7 to 11 cm. long, 2 to 3.5 cm. wide, acuminate at apex, rounded at base, membranous, glabrous above, densely pilose on nerves beneath with divaricate whitish hairs; bracts leaflike, persistent, varying in size in individual plants from 5 to 7 cm. long and 1 to 2.5 cm. wide, petiolate, pilose on nerves beneath; umbel rays 4 to 7, 15 to 25 cm. long, glabrous, twice or thrice-forked above middle, bracteolate at the forks, the lowermost bractlets oblong-lanceolate, 1 to 1.5 cm. long, 2 mm. wide; ovary broadly turbinate, glabrous; perianth segments equal, 2 to 2.5 cm. long, the sepals obovate-oblong, 1 to 1.2 cm. wide, pinkish without, yellowish or cream-color within, green-tinged at apex; petals oblong-spatulate, 8 to 11 mm. wide, yellow, green at apex, purple-dotted within; stamens equal, slightly shorter than the perianth, the anthers ovate, 4 to 5 mm. long, 2 mm. wide; fruit turbinate, about 2 cm. in diameter, orange.

Type in the U. S. National Herbarium, no. 1,574,158, collected near Vetas, Department of Santander, Colombia, altitude 3,100 to 3,250 meters (Eastern Cordillera), January 19, 1927, by E. P. Killip and A. C. Smith (no. 17881). Represented also by several other Killip and Smith collections from the departments of Santander and Norte de Santander.

This species most nearly resembles *B. moritiziana*, but differs in having glabrous rays and ovaries, larger flowers, and obovate-oblong sepals.

Bomarea (*Eubomarea* § *Edules*) **perlongipes** Killip, sp. nov.

Caulis et folia desunt; bracteae late ovato-lanceolatae, subtus dense hirsutae; radii 10 (vel ad 20?), perlongi, crassi, erecti vel adscendentes, glabri, supra medium bifurcati, bracteolis ovato-lanceolatis, infimis magnis; ovarium cylindrico-turbinatum, glabrum; segmenta perianthii aequalia, sepalis obovato-oblongis, roseis, petalis oblongo-spathulatis, luteis, brunneo-maculatis.

Stem and leaves wanting; bracts broadly ovate-lanceolate or oblong-lanceolate, 7 to 11 cm. long, 2 to 5 cm. wide, abruptly acuminate at apex, subacute at base, glabrous above, densely hirsute beneath; umbel rays 10 (up to 20?), about 40 cm. long, stout, erect or ascending, glabrous, twice-branched above middle, bracteolate at forks, the bractlets ovate-lanceolate, acuminate, glabrous above, sparingly hirtellous and puberulent beneath, the lowermost 6 to 7 cm. long, 2 to 2.5 cm. wide, the upper decreasing in size; ovary cylindric-turbinate, glabrous; perianth segments equal, 4 to 5.5 cm. long, the sepals obovate-oblong, 7 to 8 mm. wide, callous-thickened at apex, rose, the petals oblong-spatulate, 1.2 to 1.5 cm. wide, yellow, brown-spotted; stamens 3 to 3.5 cm. long.

Type in the herbarium of the Muséum National d'Histoire Naturelle, Paris, collected in the Province of Ocaña, Department of Norte de Santander, Colombia, altitude about 1,525 meters, July (1846-1852), by L. Schlim (no. 718).